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Forest Scientists to Test Moon Rock



Behind the "biological barrier" at the Lunar Receiving Laboratory at NASA's Manned Spacecraft Center in Houston, Texas, Forest Service scientists prepare to make four types of tests to find effects of lunar materials on earth's plant life. Plants will be exposed to moon materials within a sterile, sealed cabinet system.

Forest Service researchers going to the moon? Not yet. But scientists from the Southern Forest Experiment Station prepare at the Lunar Receiving Laboratory in Houston, Texas, to perform vital tests when earth's first travellers return from a lunar landing—possibly later this year. The laboratory is a part of the National Aeronautics and Space Administration's Manned Spacecraft Center in Houston.

USDA's Forest Service scientists must show that there is no non-earth pathogen harmful to plant life in powdered lunar rock materials collected by the astronauts. And they will measure other effects of lunar materials on plants in a series of

tests now being set up in the botanical section of NASA's Lunar Receiving Laboratory (LRL). Dr. Charles H. Walkinshaw, Jr., previously research plant pathologist from the Southern Station's Gulfport, Mississippi, laboratory, is stationed in the botanical section of the LRL and will conduct the tests. He is being assisted by Dr. John A. Vozzo from the Southern Station's Stoneville, Mississippi, laboratory. A USDA scientist from Agricultural Research Service will screen the effects of lunar rock materials on insects.

One in a Trillion

The possibility that any kind of life exists on the moon is ex-

tremely remote. The moon has little atmosphere and seems to have no water-high vacuum conditions. It is seared by radioactivity, bombarded by meteorites, and the temperature varies from 230 to minus 280 degrees Fahrenheit. But there is the slim, slim chance that some form of life there, if only a rudimentary bacterium or virus, could be hostile to earth life and so different to anything on earth that neither plants, animals, nor humans would have resistance to its attack. Because of this risk, the astronauts and everything they carry with them will be quarantined and treated with meticulous care.

Not to be overlooked is the danger of earthlings contamin-



Lunar Receiving Laboratory in the foreground is a vital part of NASA's Manned Spacecraft Center in Houston. Here earth's first travellers to the moon will remain in quarantine behind a "biological barrier" for 21 days while on elaborate series of tests is made.

ating the moon. There, in a vacuum under ultraviolet radiation, it is conceivable that an earthly virus could find protection and moisture under a rock and run rampant.

What will a little moon dust do to your tomato plants? Probably nothing. But to find out, four types of botanical tests will be made to determine the Apollo mission's goals concerning effects of lunar materials on earth's plant life.

First, crushed or powdered moon rock will be added to the cultures of four species of algae grown in sterile (free from other forms of life) culture in liquid. Algae are considered important since they are the food supply of many animal species and are important suppliers of oxygen in the sea and on land. Sterilized lunar materials will be added to some, earth materials to others, and nothing to some. Then all will be studied for comparative effects on growth and structure.

A second type of testing will deal with germination of surface-sterilized seeds known to be

free of internal pathogens and organisms. Seeds are first dehulled, washed carefully, surface-sterilized by a variety of disinfectants, and then re-washed and placed on substrate for germination. The seeds will be directly exposed during their germination to the powdered materials from the moon. To leave no doubts about the answer, the list of plants for the tests covers a vast variety including potato, tomato, tobacco, cabbage, onion, beans, slash pine, sugarcane, and fern. Most of the plants are directly important to man's survival or are chosen because they are well established as test plants.

A third type of testing is for analyzing microbes that may attack growing plants. In this series plants of 13 species will be exposed by rubbing the leaves with the moon-rock powder in a suspended form, then pouring the excess at the base of the plant. This will measure both toxic and pathogenic effects.

The fourth test will be exposing plant tissue cultures—masses of growing cells—to the

powdered materials from moon. These cell masses provide a useful system for reinforcing findings of the three other tests. They are sterile or free from contamination, are sensitive to toxins, and will detect pathogens that invade the cell masses as well as the media on which they are grown.

Suspicious results from any of the tests will become grounds for more detailed investigations.

Welcome Home

Elaborate plans are being made to handle every detail of the return of the Apollo crew. A reception unlike any accorded other astronauts will await their splash down in the Pacific. They will stay in their capsule while an aircraft carrier cautiously maneuvers alongside and hoists the spacecraft to the flight deck. Instead of stepping out on the flight deck they will wait until a clear plastic tunnel is extended from the door of a special trailer-like van on the flight deck and attached over the exit of the capsule.

In the tunnel, they will be welcomed by just two men—an engineer and a doctor. They will enter the van, and the carrier will head for the nearest port with a large airport. There the van, with the three astronauts and their companions inside, will be hitched to a truck and pulled to the Manned Spacecraft Center. The truck will stop at a low-lying building set slightly apart from the others—the Lunar Receiving Laboratory. The astronauts, engineer, and doctor will pass through another plastic tunnel into a kind of benevolent prison where they will remain for 21 days in quarantine.

The quarters that will house them are separated from the rest of the world by what is known as a "biological barrier." Nothing will be allowed to escape into the atmosphere without being purified. Even the air the astronauts have breathed will be filtered and treated as it passes through the air-conditioning system of the LRL. The pressure inside quarters will be slightly lower than normal, so that if there is a sudden rupture of some sort, such as a broken window, the air will flow in, not out. Technicians and doctors may enter the quarters, but they must stay until the 21-day quarantine is lifted.

Actually, tests will begin long before the astronauts reach the laboratory. The men will be examined immediately in the van aboard ship. Blood samples will be passed through an airlock and flown to the laboratory for immediate analysis. In addition, the sealed suitcase size containers carrying samples from the moon will be retrieved from the capsule and flown to the moon lab immediately. (They will be flown in separate planes for the same reason that the President and Vice-President don't fly in the same airplane.)

At the lab the outsides of the boxes will be purified by ultra-violet light and a disinfecting acid bath, then rinsed in sterile water, dried by sterile nitrogen, and moved into a vacuum chamber. Reaching inside, with arms and hands encased in the gloves of a modified space suit, the scientists will open the containers.

Some of the samples will be passed down to the radiation-counting laboratory, which is buried 50 feet in the earth and is additionally surrounded by 5 feet of concrete and 3 feet of dunite, a mineral with almost no radioactivity. The small work chamber itself is shielded by 8 inches of lead.

Particles of moon rock will be ground up, diluted, and mixed in a centrifuge. Some of the material will be tested on living cells, including those taken from fish and mammals.

Others will be introduced to plant life—and here the Forest Service comes into the action.

Plants for Moon Tests

The botanical program will be conducted within three distinct facilities, Dr. Walkinshaw explains. First is the cabinet system, a quarantine area within the sample laboratory. In these sterile cabinets the actual experiments will be performed—the plants will be exposed to lunar samples.

Second is the support laboratory, where plants are grown and prepared for the cabinets. Also, tests

will be conducted here on killed and fixed plant materials that have been removed from the cabinets.

Third is the plant holding colony, which maintains a back-up supply of germ-free plants for experiments in the cabinets. Here also a selected number of plants that have been exposed to lunar materials will be held for extended periods and examined after the release of moon rock samples to universities around the world. These will remain in quarantine to determine long-range effects.

Color photographs of the botanical materials will be taken from outside the cabinets for permanent records. Materials will be prepared

See Moon Rock, Page 6

Forest Service scientist Dr. Charles H. Walkinshaw, Jr., works within a sealed cabinet preparing to test effects of ground particles of moon rock on earth's plants.



Southern Pine Plywood is Here to Stay

The rise in importance of southern pine plywood over the past 6 years has been spectacular. Before 1963, almost no softwood plywood was manufactured in the South. The industry was concentrated in the West, and most of its products were made from coastal Douglas-fir. In late 1963, a softwood-plywood plant opened in Arkansas, and by the end of 1967, 34 southern plants were operating. They had the capacity to satisfy 21 percent of the Nation's requirements.

Southern expansion has continued into 1969, and resource planners have been forced to ask important questions about the future. Is this new industry permanent? What has induced manufacturers to come here? When will expansion cease?

In "Potential Growth of the Southern Pine Plywood Industry," Research Paper SO-41, Dr. D. L. Holley, Jr., provides some of the answers. He concludes that by 1975 most of the plywood sheathing for new buildings in the Eastern and Southern United States will be southern pine. For manufacturers in the South enjoy cost advantages for almost every operation, from log procurement to delivery of the finished product, over their counterparts in the Nation's other major softwood timber regions, the west coast and the Rocky Mountains.

In recent years, both stumpage prices and logging costs have been slightly lower in the South than in the West, and lower labor costs give the South a con-

siderable advantage in manufacturing. Prices to ship from plant to consumer vary widely by origin and destination, but distance is the major determinant. Thus, a firm in western Oregon has to pay about \$11 more than a Louisiana firm to ship the plywood made from a thousand board feet of logs to New York City.

With these favorable costs, one might well ask why pine plywood was not manufactured in the South long before 1963. There were three requirements for starting of the industry: an expanding timber inventory, in-

creasing demand for sheathing-grade plywood, and improved mill technology. All requirements were not met until the 1960's.

By then, the South's forests had recovered from past abuses. Pine growth was exceeding cut by a wide margin in most Southern States, despite a mushrooming pulp and paper industry. Meanwhile, log supplies in western Washington and Oregon were sometimes falling short of the capacity of existing plants.

Changes in construction practices since World War II have



Southern pine plywood makes excellent sheathing.

ade sheathing the largest selling plywood product. For this purpose, strength and durability are the chief requirements, and southern pine is entirely suitable.

Before small logs could be peeled profitably, high-speed lathes and lathe chargers had to be designed. They were, and USDA Forest Service scientists developed adequate gluing techniques for the new material. When it became apparent that southern pine plywood could be manufactured profitably, the Forest Service spread the word

to potential plant builders, and the new industry was born.

To find the potential for continued expansion, Dr. Holley developed a linear model of the plywood and lumber industries which takes into account the location of sawtimber supplies and regional differences in logging, manufacturing, and transportation costs. The location of plywood and lumber consumption was also considered in arriving at the computer programming solution. He chose 1975 for projections and tested several assumptions about regional

changes in wage rates. The conclusion: By 1975, the South should be producing at least 6 billion square feet of plywood—30 percent of the Nation's expected needs. If lower wages prevail in the South, the percentage could be far higher.

Dr. Holley predicts that continued rapid expansion will hold down prices paid by southern and eastern consumers of plywood. He also foresees rises in southern stumpage prices, and therefore profits from forestry, as competition for pine trees increases.

To Tame the Rain



Forest scientists can't control rainfall, but they do learn ways to manage southern watersheds for the greatest use of rainfall. Runoff from forested watersheds in Arkansas is measured at 11 gauging stations such as this one.

Aim is to prolong summer flow of streams and reduce damaging floods in the Ozark Plateau and Boston and Ouachita Mountains. At these locations Southern Forest Experiment Station researchers also study how amounts and

types of vegetation and ground cover affect water intake, storage, and movement in soils. Field studies are on the Alum Creek Experimental Forest near Hot Springs, the Koen Experimental Forest near Harrison, and at plots supplied by landowners and industries throughout the mountain areas.

O—O

Only 1 in 20 Americans were city dwellers back in 1790. Today, 14 out of 20 are. But the tide may be turning. A recent booklet, "Communities of Tomorrow," published by the U. S. Department of Agriculture, outlines potentials for rural living as an aid in solving the Nation's present people/opportunity imbalance.

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for observation under an electron microscope capable of magnifying to 80,000 $\times$.

Besides performing the very important function of quarantining lunar samples, the botanical program will furnish much valuable basic scientific information, Dr. Walkinshaw said.

"Does a germ-free plant decay when it dies?" he asked. Nobody knows. Never before has the opportunity existed to test plant life under sterile conditions to the extent provided for in the Lunar Receiving Laboratory. The need for closed ecological systems in long-range missions—where men will live perhaps 1,000 days in space—makes it necessary to begin now certain tests that have not been done before, he said.

Achieving entirely sterile quarantine conditions has revealed almost unbelievable complications. Germs are found to travel freely between the insulation and wire in cabinetry. They go through water-tight compartments in what appear to be impermeable stainless steel boxes.

Need for early completion of the plant-holding colony and the support laboratory is pressing. The supply of sterile plants must be ready when the Apollo crew is ready, and plants can't be grown overnight—at least not yet.

"The test system developed from the moon shots will provide a basis for what we do in the future when we are ready for landings on other planets where possibility of life is less remote," the LRL plant pathologist said.



It's the Humidity

High humidity is erroneously blamed for many of man's troubles. In the case of fusiform rust, one of the most serious hazards in southern pine forests, the accusation is probably correct.

Recent studies indicate that this disease spreads only when the humidity is close to the saturation point. The rust is caused by the fungus *Cronartium fusiforme* and requires two hosts, pines and oaks, to complete its life cycle. Slash and loblolly pines suffer most from the disease. They are infected in spring by spores that travel from oaks to pines. To protect pines, needles must be coated with fungicide when spores are flying.

Four articles by Dr. G. A. Snow and colleagues of the Southern Forest Experiment Station were published recently in *Phytopathology*. The articles define the environmental requirements for germination of spores and infection of pines. They also tell how long these processes take.

The authors found that spores of the fungus were produced frequently during the spring in a stand of hardwoods and pines in south-central Mississippi. Occurrence was closely related to humidity, and spores were most abundant during nights follow-

ing a rain in the afternoon or early evening. Spores first appeared when the humidity reached 97 percent and their numbers increased rapidly during the next 4 to 6 hours. Temperatures between about 60° and 80° F. are favorable for spore production.

Reprints of the four scientific articles are available on request from the Southern Forest Experiment Station.

Mississippi Timber Inventoried

Results of a new timber inventory of Mississippi have been released by the Forest Survey Unit of the Southern Forest Experiment Station. The Mississippi Forestry Commission and industrial firms cooperated in the inventory.

The report, "Forest Statistics for Mississippi Counties," contains tables that give data on forest acreage and timber volume. For each county in the State, volumes of growing stock are given in cords and cubic feet, by species group. Sawtimber volume in board feet is shown by species group and diameter class. Estimates of annual growth and cut are also provided.

Forest Survey resource analysts are now finishing their interpretations of the changes in Mississippi's forests since the previous inventory in 1957. Their findings will be published in a separate report later in the year.

Copies of the current report are available from the Southern Forest Experiment Station, 70 Loyola Avenue, New Orleans, Louisiana 70113.



Breeding Better Trees

Cross breeding species of southern pine is producing a new look in trees with beauty a lot more than bark deep.

Hybrids may or may not have better form than their parents, but their increased resistance to forest disease is what puts the twinkle in a forest geneticist's eye. If the scientist finds that the hybrid also is more adaptable to growing on difficult sites, he knows he has a winner.

Studies at the Institute of Forest Genetics at the Southern Forest Experiment Station's Gulfport, Mississippi, laboratory indicate that all the major southern pines can be crossed with each other, but not with equal ease.

Until recently, longleaf and shortleaf pines seemed incompatible for crossing, and producing a hybrid seemed impossible. But Forest Service scientists have finally succeeded, gaining desirable characteristics from each.

In the photos above the longleaf $\times$ shortleaf hybrid (center) shows pleasing form compared

to the longleaf (left) and the shortleaf (right). The trees are 6 years old, producing seeds, and claimed successful as hybrids. Important gain in this cross is that the shortleaf $\times$ longleaf hybrid does not have the grass stage in which the longleaf normally remains for several years before putting up a stem.

Some hybrids show good resistance to fusiform rust, a major enemy of southern pine. The resistance is brought into the crosses either by longleaf or shortleaf. Future research will determine how adaptable the hybrids are to a variety of sites and climatic conditions. The Gulfport Institute started extensive tests about a year ago covering the southern range of shortleaf pine.

Recently issued Forest Research Paper SO-36, "Performance of Southern Pine Hybrids in South Mississippi" by Dr. Dan Schmitt, gives a detailed report of cross-breeding southern pines. Copies are available from Southern Station headquarters in New Orleans.

South Carolina's Timber Supply Increases

Results of the fourth State-wide survey of South Carolina's timber resource have been released in a report titled "South Carolina's Timber, 1968." The report shows that the area of commercial forest land increased from 11.9 to 12.4 million acres, or 4 percent, between 1958 and 1968. The increase resulted from extensive tree planting as well as natural reversion of idle agricultural land to forest. Commercial forests now occupy 64 percent of the land area in S. C.

Over the same 10-year period, volume of growing stock increased from 10.3 to 12.4 billion cubic feet, or 19 percent. This increase reverses a downward trend in timber volume between the two previous surveys, and is attributed to stepped-up efforts to increase the timber supply through improved forest management and protection. Increases in the volume of loblolly and slash pine accounted for almost one-half of the net gain.

The 1967 growth exceeded cut by more than 200 million cubic

feet, or 48 percent. Growth is still at least one-third below potential, however. About 1 out of every 4 acres is poorly stocked, primarily because inferior trees and inhibiting vegetation occupy about one-fourth of the growing space.

During the fifties, a decline in the removals of saw logs, together with the continuing decline in fuelwood use, tended to offset the increased removals of pulpwood and veneer logs. This slack in annual wood requirements was temporary, and is now being taken up rapidly.

Other findings include a shift in forest ownership from farmers to the miscellaneous private category, which includes business and professional people, wage earners, housewives, retired people, and others. There was also a 14 percent increase in the pine and oak-pine forest types and a 33 percent increase in sapling and seedling stands between 1958 and 1968.

The report was issued by the Southeastern Forest Experiment Station. The South Carolina Commission of forestry and Clemson University Extension Service cooperated in providing information. Authors are Herbert A. Knight and Joe P. McClure, Resource Analysts of the Southeastern Station.

Copies are available from the Southeastern Station, P. O. Box 2570, Asheville, N. C. 28802.

O—O

NASA, in cooperation with USDA's Forest Service, tests astronauts and their equipment on the Deschutes National Forest in Oregon. This is one of the best areas in the United States to simulate moon walking conditions.

Wood Windows Wanted

About half the windows used in new single-family homes are wood, but the proportion varies widely among cities, depending on geographical location. Most of the other windows are of aluminum. Homebuilders choose lumber predominantly for shelving material, but show considerable interest in other materials such as particleboard, plywood and metal.

Surveys revealing these preferences and the reasons for them were made of builders in 20 cities throughout the Nation, including five in the South, by researchers at the Intermountain Forest and Range Experiment Station at Ogden, Utah. Findings have been published as Research Paper INT-55, "Factors That Affect the Single-Family Home Market for Wood Windows," and Research Note INT-83, "Factors That Affect Choice of Shelving Materials in Single-Family Homes."

Maintenance requirements and performance characteristics account for many of the geographical differences in use of wood windows. The builder is the principal decision maker, but home buyers and suppliers influence his choice. Use of wood windows predominates in the North and East and varies with the price of the house. Only 21 percent of the houses priced under \$20,000 use wood windows, compared to 57 percent of those priced over \$30,000.

Builders don't necessarily limit their use of windows in a house to one material. In 15 percent of the houses, for example, builders use both wood and aluminum—usually wood windows on the front of the house and aluminum on the sides and rear.

Maintenance requirements chiefly favor aluminum windows. Wood windows are preferred because of their insulating qualities and for being condensation free. Opinions are about equally divided as to whether wood or aluminum has the advantage in fit and operation. Appearance of wood windows is a major factor in their use. Style and architecture of the home determine the type of windows used, but not the material.

Although lumber has traditionally been the most common material used for shelving, in recent years alternate materials have been adopted. These include plywood, metal, and particleboard, which utilizes wood residues, species, and grades often difficult to market as lumber.

Southern pine is favored by builders in several cities, though ponderosa pine and white pine account for most lumber shelving. Hardwood lumber is also used for bookshelves.

Improvements to eliminate warping, sagging, and surface defects are factors that interest builders in new shelving materials. Potential cost savings in reducing labor time needed for cutting, installing, and finishing shelving materials favor use of a shelving "package," such as metal shelves manufactured to size.

Both the Research Paper and the Note are available from the Intermountain Station.

O—O

To provide the technical knowledge to double the timber harvest in the Midsouth by 2000 A.D. is one of the goals of the Forest Service's Southern Forest Experiment Station, which has headquarters in New Orleans.